AUSTRIAN PATENT OFFICE

Cl. 46c$_1$, 12/01

# PATENT SPECIFICATION NO. 198069

Issued 10th June 1958

DIPL.-ING. DR. TECHN. HANS LIST, GRAZ

## Trunk piston, especially for two-stroke internal combustion engines

Filed 26th April 1957. Start of duration of patent: 15th November 1957.
Inventor: Dipl.Ing. Dr. techn. Siegfried Pachernegg, Graz.

In two-stroke engines, in contrast to engines which operate according to the four-stroke principle, there is barely any change in the bearing point of the piston pin against the piston bosses. This rules out the formation of a load-carrying lubricant layer, since no pumping action arises between the bearing surfaces of the piston bosses, in which the piston pin is mounted, and the surface of the piston pin to convey splash oil into this bearing gap. The known attempts to solve this problem, in which a plurality of radial bores in the piston bosses were intended to allow the splash oil to pass from the outer surface of the piston bosses into the bearing gap did not produce a satisfactory result. Oil holes extending from the top are dangerous with regard to the strength of the piston boss. To collect the splash oil in the piston pin bosses and distribute it over the bearing surface of these bosses, it has already been proposed to arrange axial lubrication channels on the side remote from the piston head or on the diameter of the piston pin boss lying perpendicularly to the longitudinal piston axis. While in four-stroke internal combustion engines, in which the piston pin bears alternately on opposing sides of the piston pin bosses, these channels enable an oil-distributing pumping action on the quantity of oil collecting in the channels, in two-stroke internal combustion engines these channels have no effect; due to the lack of a special scavenging stroke, no change occurs here in the bearing situation in the piston pin bosses by which the oil would be alternately sucked into the channels and distributed therefrom onto the bearing surface. Supplying the channels through oil holes in the piston pin bosses likewise does not provide a satisfactory solution, since the quantity of oil conveyed through the oil holes, the number of which is restricted for reasons relating to strength, is modest. It would therefore seem expedient to enlarge as far as possible the free portion of the piston pin surface located between the connecting rod bearing and the piston pin bosses and to convey the oil collected therein into the bearing gap.

The invention is based on the observation, with regard to improving lubrication of the piston pin, that every piston pin, in addition to its oscillatory motion corresponding to the connecting rod movement, rotates in one of the two directions of the oscillatory motion. The movement of the pin in this "preferred direction of movement" is exploited here for the purpose of conveying the lubricating oil, which collects on the piston pin between the connecting rod eye and the piston boss or which exits from the connecting rod eye and flows off along the piston pin, in the direction towards the outer circumferential surface of the piston skirt. To this end there are provided channels which extend in a helical line in the bearing surface of the piston

boss. The inclination of the helical line and its lead need to be determined in accordance with the requirement to convey the lubricant out of the inside of the piston in the direction of the outer circumference of the piston, taking account of the preferred direction of movement of the piston pin. The result is that, if a right-handed helical channel is provided in one boss of the piston, the helical channel in the other boss must be left-handed. In order nonetheless to achieve even distribution of the lubricant over the entire bearing surface of the bosses with a small number of turns of the helix, it is advisable to provide a plurality of helical channels, which correspond in their course to a multi-start screw.

It has already become known to use helical channels in bearing surfaces to recirculate lubricant which moves in the form of a film along a shaft, in the case of housing feed-throughs and the like. However, the proposal of the invention differs from these embodiments principally in its contrary mode of action, i.e. conveying of the lubricating oil into the bearing point, making use of the knowledge that the piston pin is rotated on stepwise in one direction.

The drawing shows by way of example a piston according to the invention in longitudinal section. In the bearing surfaces 1, 1' of the piston pin bosses 2, 2' there are arranged helical channels 3, 3' of opposing pitch. The triangular cross-section of the channel indicated in the illustration could of course be replaced by another cross-sectional shape. The pitch of the helical lines indicating the course of the channels should preferably be selected to be less than the length of the piston boss.

## CLAIMS:

1. A trunk piston, in particular for two-stroke internal combustion engines, having lubricating oil channels contained in the piston pin bosses, characterised in that the bearing surface of each piston pin boss (1, 1') contains at least one helically extending lubrication channel (3, 3'), whose pitch is preferably less than the length of the bearing surface of the piston pin bosses and whose inclination is determined taking into consideration the preferred direction of rotation of the piston pin in such a way that lubricant located on the piston pin is conveyed inside the piston boss towards the outer surface of the piston skirt.

2. A piston according to claim 1, characterised in that the channels take the form of a multi-start helical line.

---

1 page of drawings

---

No. 476 204 Patent Specification No. 476 204

SWISS PATENT OFFICE

International Classification: F 01 m 1/08
Application no.: 8151/67
Application date: 8th June 1967

Patent Granted: 31st July 1969
Patent specification published: 15th September 1969

# MAIN PATENT

Gebrüder Sulzer, Aktiengesellschaft, Winterthur

## Arrangement for lubricating a trunk piston of a piston internal combustion engine

Inventor: Hans Perrin, Winterthur

The invention relates to an arrangement for lubricating a trunk piston of a piston internal combustion engine, which is characterised by at least one duct leading out of the inside of the piston through the piston skirt to its sliding surface, which duct serves to convey lubricating oil out of the lubrication system through the wall of the piston skirt to the sliding surface.

It is known that trunk pistons of piston internal combustion engines have to cope with considerable lateral forces, which are caused by the gas pressures in the event of an obliquely positioned connecting rod. For this reason, in engines subject to severe loading, such as highly supercharged diesel engines, there is considerable risk of piston seizure. It has been demonstrated that this risk may be countered by increased lubrication of the sliding surfaces of the piston skirt and the cylinder wall.

Lubricating arrangements for piston internal combustion engines are already known in which lubricating oil is fed to the sliding surfaces through openings in the cylinder wall. However, these arrangements are disadvantageous insofar as the cooling jacket has to be passed through. This creates additional sealing points for the lubrication lines at the points of passage through the housing and the cylinder liner. In addition, there are problems regarding metering the lubricating oil and conveying it, since, due to the changing position of the piston, the lubrication openings may occasionally open above the momentary position of the piston into the combustion chamber, which may result in oil losses.

The object of the invention is to provide an arrangement which allows increased lubrication of the sliding surface of the piston and the cylinder liner, reduces or eliminates the risk of cylinder seizure, is significantly simpler than the above-mentioned known arrangements and may in particular be retrofitted without difficulty to existing engines.

The duct may take the form of an opening in the piston skirt, which opening is located at a point of the piston skirt which is subject to load. In this case a nozzle may be provided on one part of the piston internal combustion engine, which nozzle is connected to the engine lubrication system and serves to convey a jet of lubricating oil

into the opening. Such a measure has the advantage that it requires little effort and, as already mentioned, may also be applied to existing engines without difficulty.

It is preferably possible to provide the nozzle on one side of the connecting rod small end located in the piston and to arrange the opening in the wall of the skirt opposite the nozzle. In this way it is possible, with the simplest of means, to provide additional piston lubrication, in particular if the engine already comprises an oil feed via ducts in the connecting rod, e.g. for cooling the piston.

However, it is also possible to provide the opening with a deflection element and to arrange the nozzle in an immobile part of the engine housing, wherein the jet exiting from the nozzle is directed towards the deflection element. Such an arrangement may be advantageous in particular in engines in which the connecting rod is not provided with oil ducts for feeding oil into the piston.

It is also advantageous to provide the piston skirt with lubrication channels at the points subject to load, which channels serve to distribute the oil over the sliding surface of the piston. In this way, despite the oil being supplied via a single opening, it is evenly distributed over the sliding surface.

It is also possible to arrange two oil wiper rings between the sliding surface of the piston and the sealing rings, which oil wiper rings may be of the known design. In this way, lubricating oil may be prevented from escaping from the sliding surface into the combustion chamber of the cylinder in question, so countering an increase in oil consumption due to the increased lubrication.

The invention will be explained with reference to embodiments illustrated schematically in the drawings, in which:

Fig. 1 shows a section of a trunk piston according to the invention, taken through the plane of the piston axis, perpendicularly to the axis of the piston pin,

Fig. 2 is a partial view with partial section of another embodiment of the piston, in which lubricating oil is supplied to the sliding surface by interconnected ducts for the lubricating oil.

Fig. 3 shows a further embodiment of the piston in section, in which an immobile spray nozzle is provided in the engine housing.

Fig. 1 shows a piston 1 of a piston internal combustion engine, which is connected by a piston pin 2 to a connecting rod 3. The piston pin is mounted in the connecting rod in a bearing bushing 4, which comprises an oil channel 5 and bores 6, 7. The oil channel 5 and the bores 6 and 7 are connected in known way with axially extending bores 8, 9 in the connecting rod. The bores are connected to the lubrication system of the engine, which contains oil conveyed with overpressure by a lubrication pump. The bore 9 serves, also in known manner, in forming a jet 10 of lubricating oil, which is directed towards the head 11 of the piston 1 and cools it.

The piston illustrated in Fig. 1 is provided with openings 12, which pass through the piston skirt and lie in the axial plane which is perpendicular to the axis of the piston pin 2. Opposite the openings 12 there are bores 13 in the small end of the connecting rod 3, which bores 13 are connected to the channel 5 via bores 14 in the bushing 4. The bores serve, like the bore 9, as nozzles, from which a jet of lubricating oil is discharged. The jet leaving the bores 13 passes out through the openings 12 and impacts against the cylinder wall of the engine, not shown. The sliding surface of the piston skirt may be provided with per se known lubrication channels 15 for better distribution of the oil.

As is clear from Fig. 1, between the normal grooves 16 for sealing rings, which are located in the vicinity of the piston head 11, and the sliding surface of the piston skirt with the opening 12 and the lubrication channels 15 there are located two

wiper rings 17 for oil. The wiper rings 17 are of known construction and are likewise arranged in known manner in grooves 18, which are connected by ducts 19 with the inside of the piston. The wiper rings 17 prevent the lubricating oil supplied in ample quantities to the sliding surface from reaching the sealing rings and the combustion chamber. The wiped-off lubricating oil is carried away through the ducts 19 into the inside of the piston and thence into the crankcase.

In the embodiment illustrated, the piston 1 is provided at the bottom end of the piston skirt with a wiper ring 20 of the same construction as the wiper rings 16. This wiper ring may assist in better distribution of the oil adhering to the sliding surface of the cylinder liner. It may possibly be advantageous, however, to dispense with this wiper ring.

Fig. 2 shows a piston 21 with a piston pin 22 and a connecting rod 23. The connecting rod 23 is provided with a bearing bushing 24, which comprises a lubrication channel 25, which is connected by a bore 27 to a longitudinal bore 28 in the connecting rod. The bore 28 is likewise in known manner connected to a lubrication line with pressurised lubricating oil.

In the embodiment illustrated in Fig. 2, the cavity 29 in the piston pin 22 is closed by a sealing disk 30 and is connected by bores 31 to the lubrication channel 25. Moreover, the pin 22 is provided with bores 32, which are connected to oil channels 33 in the bosses of the piston 21. Bores 34 lead out from the channels 33 to the sliding surface of the piston. Lubrication channels 35 are connected to the bores 34.

In this embodiment, the lubricating oil supplied through the bore 28 in the connecting rod passes through the bore 27, the lubrication channel 25 and the bores 31 into the bore 29 in the piston pin, which fills with oil. From the bore 29, the oil passes out through the bores 32 and the oil channels 33 together with the bores 34 to the sliding surface, where it is distributed by the lubrication channels 35.

This embodiment has the advantage of forced conveyance of the oil under pressure from the connecting rod to the sliding surface.

Fig. 3 shows a section of a piston taken along two different section planes, wherein one extends through the axis of the piston boss and the other extends at an angle, e.g. perpendicularly thereto. The two section planes intersect in the longitudinal axis of the piston. The piston 41 illustrated in Fig. 3 is provided in its skirt 42 with a bore 43, which passes out of the inside of the piston to the sliding surface and opens therein. Upstream of the bore 43 there is provided a deflection element 44. The oil jet 45 from a nozzle 46 is directed towards the deflection element 44. The nozzle may be arranged at any desired point in the housing of the engine and is connected to the lubrication system, i.e. the line conveying the pressurised lubricating oil.

In this embodiment, the oil jet 45 exiting from the nozzle 46 impacts against the deflection element 44 and passes from there through the bore 43 to the sliding surface, which may likewise in known manner be provided with lubrication channels 47 for distributing the lubricating oil. The embodiment illustrated in Fig. 3 is particularly advantageous in piston internal combustion engines in which no lubricating oil is supplied to the piston pin through the connecting rod.

## PATENT CLAIM

An arrangement for lubricating a trunk piston of a piston internal combustion engine, characterised by at least one duct leading out of the inside of the piston through the piston skirt to its sliding surface, which duct serves to convey lubricating oil out of the lubrication system through the wall of the piston skirt to the sliding surface.

SUBORDINATE CLAIMS

1. An arrangement according to the patent claim, characterised by an opening in the piston skirt, which opening is located at a point of the piston skirt which is subject to load, and by a nozzle arranged on one part of the piston internal combustion engine, which nozzle is connected to the engine lubrication system and serves to convey a jet of lubricating oil into the opening.

2. An arrangement according to subordinate claim 1, characterised in that the nozzle is provided on one side of the connecting rod small end located in the piston and the opening is located in the wall of the skirt opposite the nozzle (Fig. 1).

3. An arrangement according to subordinate claim 1, characterised in that the opening is provided with a deflection element and the nozzle is arranged in an immobile part of the engine housing, wherein the jet exiting from the nozzle is directed towards the deflection element (Fig. 3).

4. An arrangement according to any one of subordinate claims 1-3, characterised by lubrication channels, which serve to distribute the lubricating oil over the sliding surface of the piston.

5. An arrangement according to any one of subordinate claims 1-3, characterised by two oil wiper rings, which are located between the sliding surface and the sealing rings of the piston.

Gebrüder Sulzer Aktiengesellschaft